USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002DC4B

Title: Properties and Applications of the Box-Cox Distribution

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Abstract

The Box-Cox translation system produces the Box-Cox family of distributions. This transformation has proved useful when dealing with environmental data. We study the properties and applications of this distribution. The Box-Cox translation system generates the Box-Cox family of distributions. Determining appropriate transformation parameters may be a challenge in practice. As an aid for parameter selection, we will study contour and 3-dimensional plots. These plots should be helpful in the early stages of selecting a distribution. We study the moments of this distribution and obtain expressions for the mean vector and the covariance matrix for specified values of the transformation parameter. We investigate the conditional distributions and show that the conditional distributions are also in Box-Cox family. We use the Fre'chet bounds to obtain expressions for the lower and upper bounds of the correlation for selected parameters. We use a computational scheme to calculate the correlation bounds for any specified transformation parameter. We show that the correlation of coefficient on the original scale is a function of correlation of on the transformed scale. It can also be shown that the attainable correlation can be mu ch more restricted than (-1, +1) range. Chevyshev-Hermite polynomials are used to obtain expressions for the moments of X for integer values of the transformation parameter. We obtain an expression for the correlation in the untransformed scale and expressions for the univariate quantile functions. They are use to describe the behavior of the order statistics of a random sample from this distribution. We identify the median and the range of the minimum and maximum sample values and show that the power of the normal theory test of independence increases after a Box-Cox transformation to normality. We use this distribution to model univariate and bivariate data from a water treatment plant.